Table S1 The performance of CID in RCC with different pathologic types

Pathologic Type	P-value					
	Zhongshan cohort			External test set		
	DSS	RFS	OS	DSS	RFS	OS
ccRCC	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*
pRCC	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*
chrRCC	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*
Other Malignant[a]	<0.001*	<0.001*	<0.001*	0.001*	0.001*	0.001*
non-ccRCC	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*

Note: * indicate statistical significance; CID, contour irregularity degree; a. Other malignant tumors included mucinous tubular and spindle cell carcinoma, tubulocystic RCC, eosinophilic solid and cystic RCC, Xp11 translocation RCC, etc. RCC, renal cell carcinoma; DSS, disease-specific survival; RFS, recurrence-free survival; OS, overall survival; ccRCC, clear cell renal cell carcinoma; pRCC, papillary renal cell carcinoma; chrRCC, chromophobe RCC.

Table S2 The performance of CID in RCC with different ISUP grades

ISUP Grade	P-value					
	Zhongshan cohort			External test set		
	DSS	RFS	OS	DSS	RFS	OS
Grade 1	0.001*	<0.001*	0.023*	<0.001*	<0.001*	<0.001*
Grade 2	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*
Grade 3	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*
Grade 4	0.044*	0.002*	0.044*	0.044*	0.048*	0.030*

Note: * indicate statistical significance; CID, contour irregularity degree; RCC, renal cell carcinoma; ISUP, the International Society of Urological Pathology; DSS, disease-specific survival; RFS, recurrence-free survival; OS, overall survival.

Table S3 Univariate and multivariate analyses for DSS in patients with ISUP grade 2 and 3 tumors

Variable	Training set		
	Univariate analysis	Multivariate analysis	
	P-value	HR (95%CI)	P-value
Age (≤60/>60)	<0.001*		
Sex (female/male)	0.852		
T stage (I/II/III/IV)	<0.001*	1.59(1.26-2.01)	<0.001*
Necrosis (no/yes)	<0.001*	1.91(1.20-3.01)	0.006*
Lymph node involvement (no/yes)	<0.001*	2.28(1.12-4.67)	0.023*
Sarcomatoid differentiation (no/yes)	0.206		
CID (<50%/≥50%)	<0.001*	12.21(7.73-19.29)	<0.001*
ISUP	<0.001*	2.28(2.47-12.38)	<0.001*
Tumor size, cm (4≤/4-7/>7)	<0.001*		

Note: * indicate statistical significance; DSS, disease-specific survival; HR, hazard ratio; CI, confidence interval; CID, contour irregularity degree; ISUP, the International Society of Urological Pathology.
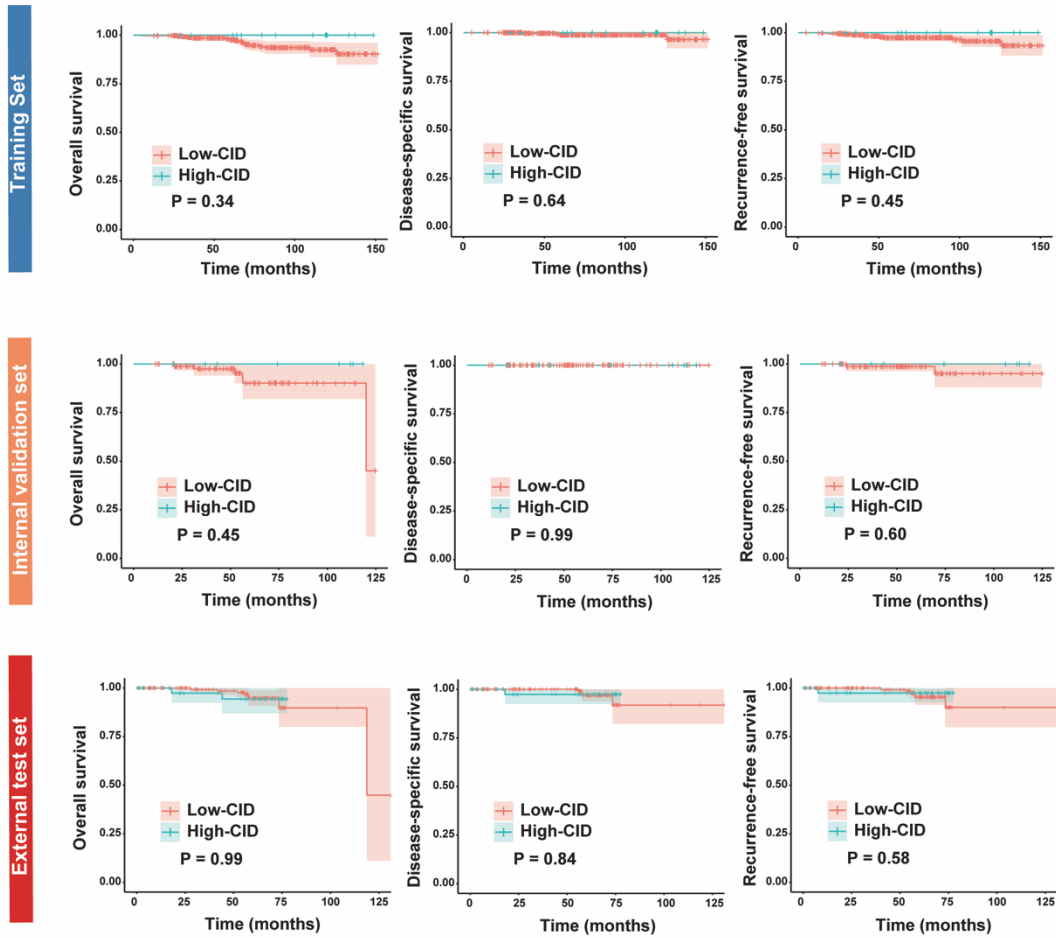
Figure S1 Kaplan-Meier estimate of overall survival (left panel), disease-specific survival (middle panel) and recurrence-free survival (right panel) stratified by contour irregularity degree in RCC patients with tumors measuring smaller than 3cm across the training set, internal validation set, and external test set. RCC, renal cell carcinoma.
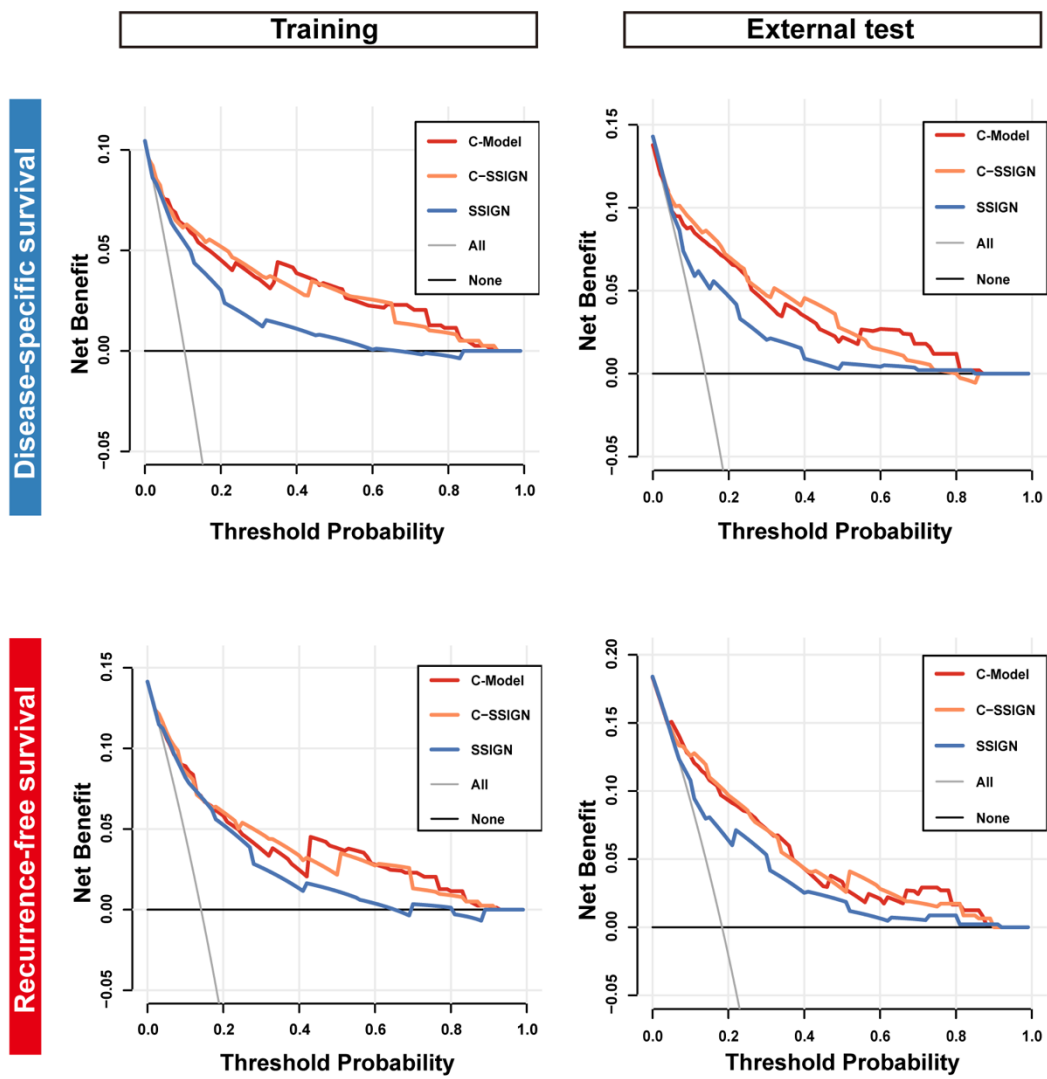
Figure S2 Decision curve analysis for disease-specific survival (upper panel) and recurrence-free survival (lower panel) between two CID-based nomograms (C-Model and C-SSIGN) and the SSIGN model.